of scattering in every degree of intensity. Exceedingly fine examples of dichroitic action on the part of this substance are to be seen in Salviati's window in St. James's Street.* By reflected light the dishes and vases there exposed exhibit a beautiful blue—by transmitted light, a ruddy brownish yellow. The change of colour is very striking when, having seen the blue, a white cloud is regarded through the glass. Where the opalescence is strongest, the transmitted light, as might be expected, is most deeply tinged. From these examples, where the foreign ingredient is intentionally introduced, we may pass by insensible gradations to M. Lallemand's glass. The difference between them is but one of degree. Many of the bottles of our laboratory show substantially the same effect as the glass of Salviati. We can hardly ascribe to molecular action, which is constant, an effect so variable as this. It is also a significant fact that, in the case of pellucid bodies—rock salt, for example—where the powerfully cleansing force of crystallisation has come into play, M. Lallemand himself found the scattering to be *nil*. Under severe examination, rock salt itself would probably be found not altogether devoid of scattering power. I have examined many fine specimens of this substance, and have not succeeded in finding a piece of any size absolutely free from defect. A common form of turbidity exhibited by clear rock salt, when severely tested, resembles on a small scale "a mackerel sky." Nor have the specimens of Iceland spar that I have hitherto examined proved absolutely wanting in this internal scattering power.

In relation to this question, which is one of the first importance, the deportment of ice is exceedingly instructive. As a rule the concentrated beam may be readily tracked through ice, at least at this season of the year, when the substance shows signs of breaking up internally. In some cases the sparkle of motes, which are evidently spots of optical rupture, reveals the track of the beam. In other cases the track appears bluish, though rarely of a uniform blue. By causing a previously sifted beam to traverse lake ice in various directions, we are soon made aware of remarkable variations in the intensity of the scattering, and we find some places where the track of the beam wholly disappears. The convergent beam is sometimes divided by a transverse plane, one half of the cone being visible and the other invisible. In other cases the cone is divided by a plane passing from apex to base, one half shining with scattered light, and the other showing the darkness of true transparency. Now, if the scattering were molecular, it ought to occur everywhere, but it does not so occur, therefore it is not molecular. The scattering is, perhaps, in most cases due to the entanglement in the ice, when the freezing is rapid, of the ultra-microscopic particles abounding in the water. It is only by excessively slow freezing that such particles could be excluded from the ice. Purely optical ruptures of the substance itself, if minute and numerous enough, would also produce the observed effect.

The liquids which I examined in 1868 all showed in a greater or less degree the scattering of light, to which was added in many cases strong fluorescence. In no respect did the deportment of the non-fluorescent liquids which showed a blue track differ from that of the blue actinic clouds with which I was then occupied. I examined water from various sources and found it uniformly charged, not only with particles small enough to scatter blue light, but with far grosser particles. Tested by the concentrated beam, our ordinary drinking water presents a by no means agreeable appearance; some of the water with which London is supplied is exceedingly thick and muddy. Nor does distillation entirely remove the suspended matter. Soret vainly tried to get rid of it; he diminished its effect, but he did not abolish it. I was favoured a few days ago with specimens of distilled water from four of the principal London laboratories. Looked at in ordinary daylight the liquid in each case would, in ordinary parlance, be pronounced "as clear as crystal," but when placed in the concentrated beam of the electric lamp, the notion of purity became simply ludicrous. No one who had not seen it would be prepared for the change produced by the concentrated illumination. There were differences of purity among the specimens, arising, doubtless, from the different modes of distillation, but to an eye capable of seeing in ordinary light what was revealed by the concentrated beam each of the specimens would appear as muddy water. I also examined a specimen of extra purity distilled from the permanganate of potash and liquefied in a glass condenser. It contained a large amount of foreign particles; not of those which scatter blue light, but grosser ones. Such must ever be the case with water distilled in the laden air of cities and collected in vessels contaminated by such air. These facts amply justify the language applied by Mr. Huxley to the statement that solutions without particles can be obtained by the processes hitherto pursued. Such a statement could only be based upon defective observation. In the number of this journal for the 17th of March, an experiment is described in which water was obtained from the combustion of hydrogen in air, the aqueous vapour arising from the combustion being condensed by a silver surface of unimpeachable purity. In this case, though the floating particles of the air were, in the first instance, totally consumed, the water was still well laden with foreign matter. The method of obtaining water here referred to had been resorted to by M. Pouchet with a view of utterly destroying all germs, and my especial object in repeating the experiment was to reveal the dangers incident to the inquiries on which M. Pouchet and others were then engaged. But the warning was unheeded. It is not for the purpose of adding to the weight of calamities, already sufficiently heavy, that I allude to this, but rather to advertise the adventurous neophyte, who may be disposed to rush into inquiries which have taxed the skill of the greatest experimenters, of some of the snares and pitfalls that lie in his way.

JOHN TYNDALL

Royal Institution, Oct. 18

NICHOLSON'S MANUAL OF ZOOLOGY

A Manual of Zoology. By H. A. Nicholson, D.Sc. Vol. I. Invertebrate Animals. (Blackwood and Sons.)

A BOOK such as this aims at being was wanted—one which should give a little more of systematic detail than is to be found in Professor Huxley's "Outlines" or

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* Mentioned to me by a correspondent.

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Professor Rolleston's introductory chapters of his "Forms." It required, however, a man of considerable knowledge of the subject to write such a book worthily, and we doubt whether Dr. Nicholson, though he deserves credit for enterprise, was quite the man to undertake it. He excuses himself for shortcomings in plan and execution in his preface, on the score of leading a busy life. Now is it, we would ask, for men who lead lives devoted to other objects than the pursuit of zoology, to bring out educational works on that branch of science?

Having once determined not to aim at originality, Dr. Nicholson has really performed a service in reproducing so much of Professor Huxley's lectures, both the later ones and those published in the *Medical Times and Gazette* in 1856-7, as he has here, with due acknowledgment, done; for it is not everyone who can now get at those lectures for themselves. Most of the illustrations in this book appear to come from these lectures also, but this is not acknowledged. Other figures of Turbellarians we recognise as copied from an article in the *Popular Science Review*. All figures not original should be acknowledged in a work of this kind, and if it were done in this case we should find that Dr. Nicholson has seldom gone to an original source—but has copied the copies of other people. We may make exception, however, in respect of the figure of *Rhizocrinus* on page 134 and a few others which have not before made their appearance in any handbook or manual of our acquaintance; figs. 47, 67, 68, 73, which we pick out at random, are as old as the hills. It is not only as to figures that we have to regret that the author does not quote at first-hand. On page 4 the student is told that Professor Huxley has applied the name of "protoplasm" to the physical basis of life. No one would resent more than Professor Huxley this statement, seeing that Mohl's term for vegetable "Schleim" was extended to animal "Schleim," and adopted in the broad sense of the protoplasm theory by Max Schultze and Kuhne more than seven years since. Dr. Bastian's name is quoted (p. 154) in connection with the remarkable history of *Ascaris nigrovenosa*, which we really owe to Leukart and Mecznikow. The history of a science is really of sufficient importance to render it desirable to keep to it as truly as possible, and the compiler of such a work as this should not so entirely confine himself to appropriating the gleanings of others, but should shift for himself, and give us the result of inquiries among the original writers.

The account of the Annelida is not very full, nor is it accurate. The leeches are made to form an order of the group, and the common horse leech and medicinal leech are the only members of it mentioned. Oligochæta is given as a synonym for Terricola, and is divided into Lumbricidæ and Naïdidæ. The latter group is said to include *Tubifex*, and then it is said that nonsexual reproduction characterises it. The fact is that Oligochæta includes Terricola = Lumbricidæ and Enchytrœidæ, and Limicola = Sænuridæ and Naïdidæ; *Tubifex* belonging to Sænuridæ and not to Naïdidæ, and exhibiting no reproduction by budding, which is confined to the genera *Nais*, *Chætogaster*, and *Æolosoma*. The fluid of the pseudo-hæmal system in *Aphrodite* and *Polynoë* is stated to be yellow, but Claparède's researches show these worms to be anangian, with the doubtful exception of *Aphrodite aculeata*, so that they have not this fluid at all, either yellow or of any other colour. Whilst no mention is made of Haeckel's proposal to connect sponges with Cœlenterata—perhaps a judicious omission at present—we find them actually classed as Rhizopoda, which is to us a new step in the opposite direction, and not a justifiable extension of Dujardin's class. In defining the Annuloida, Professor Allman's words, relative to the Echinodermata, only are quoted as though applying to both Echinodermata and Scolecida, into which two groups Dr. Nicholson follows Professor Huxley in dividing the sub-kingdom.

The Mollusca are treated by the aid of the late Dr. Woodward's manual, due prominence being given to the homological views of Professors Huxley and Allman. Mr. Hancock is not, however, mentioned, nor are Duthier's views on *Dentalium*, nor again are the exceedingly important facts of the resemblance of development of the nervous system and chorda dorsalis of the Tunicate larvæ and of Vertebrata, established by Kowalewsky and Kupffer, alluded to.

Perhaps a greater omission is that of all reference to the Monera of Haeckel. Whatever he thinks fit to do with them, the genera *Protamœba*, *Protogenes*, *Protomyxa*, *Myxastrum*, *Protomonas*, and *Vampyrella*, deserve recognition on Dr. Nicholson's part; so also do the Labyrinthuleæ of Cienkowski. Another omission is that of the fresh-water forms of Radiolaria, described of late years by Archer, Focke, and Greef; whilst under Myriapoda, we find no mention of Sir John Lubbock's curious aberrant form *Pauropus*; no mention of *Cecidomyia* larvæ under Insects; no mention of *Rhabdopleura* under Polyzoa, though it is alluded to in connection with Graptolites, the solid axis of the latter being supposed to resemble the chitinous rod of Prof. Allman's new order of Polyzoa (*Quarterly Journal of Microscopical Science*, January 1869)—a resemblance, if admissible, not confirmatory of Sertularian affinities, by the way. Interesting transition forms, such as *Echinoderes*, *Rhabdosoma*, *Myzostomum*, are not spoken of. The curious low forms of Arachnida, belonging to the genus *Pentastomum*, are said to occur in *some* vertebrates. It should be stated definitely that a species infests man, and that one body out of every five has been said to contain specimens.

It is not an agreeable task to point out so many deficiencies; at the same time a book destined for educational purposes can least of all be excused in these matters. For all that it contains of reference to recent zoological literature, this manual might be dated ten years back, when the same condensing process applied to the same educational books would have produced much the same result.

There is a glossary to this book which should be useful; we have only looked at its first page, and did not venture further into what promised to be a new series of mistakes. There is no Greek word "aktin," a ray—though Dr. Nicholson says there is.

As a rule, the definitions of both large and small groups are well given by Dr. Nicholson, and the most original part of his manual appears to be in those paragraphs which give the geological range of the various groups; these are well and carefully done, though there are exceptions—the geographical distribution is not given with equal care. E. R. LANKESTER

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